ONTOLOGICAL NOTES ON *REMORA REMORA*

By William Beebe

(Figs. 32 to 37 incl.)

Outline

I. Organic Functional Change.

II. Comparison of two Remoras—

One 15 mm. and the other 88 mm. standard length

Cephalic Sucking Disk.

Labial Suckers.

Teeth.

Scales.

Fins.

General Proportions of Growth.

An extremely interesting as well as mysterious phase of organic, and for that matter any other kind of evolution, is not the perfect end products that we see performing their work so smoothly today, but the beginnings, the first hints of organs and structures, of functions and habits.

The most air-minded lizard which ever existed could never have become a creature of flight by launching out from trees and trusting solely to the scales on his fore-legs to fray out ultimately into wing feathers. Time after time I have seen five-foot iguanas leap into midair and when they landed in low scrub it was always their heavy hind-quarters and tail which struck first. Many years ago at the Zoological Park a pin-feathered squab gave me a hint, and from the amazingly well-developed feathers on the outside of its upper legs I turned elsewhere for additional proof and found it in the nestlings of many other birds and in the femoral wing of Archaeopteryx itself. Hence my theoretical Tetrapteryx which serves logically to bridge the first difficult beginnings in the transition from volplaning lizard to volant bird.[1]

[1] A Tetrapteryx Stage in the Ancestry of Birds, Zoologica II, No. 2, 1915.

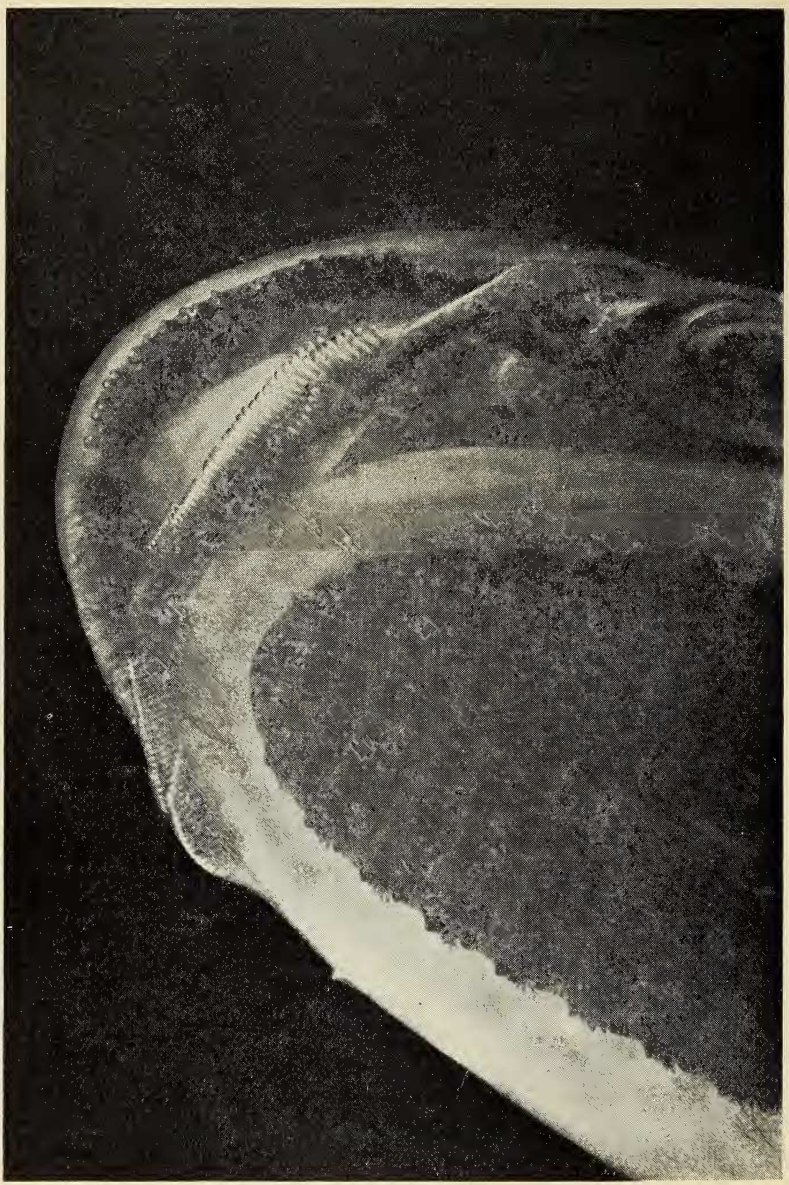

Fig. 32. *Remora remora*, 88 mm. Photograph of dorsal view of head showing functional sucking disk and teeth.

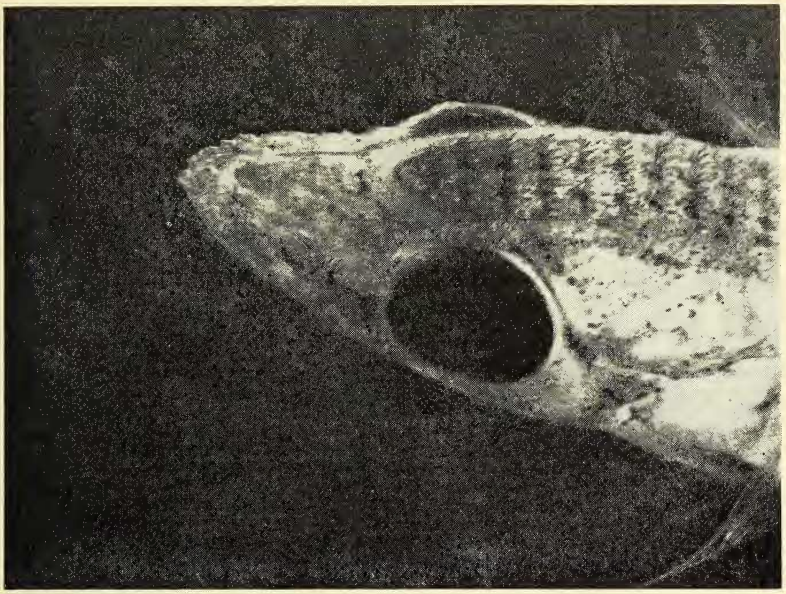

Fig. 33. *Remore remora*, 15 mm. Photograph of head from above showing larval suckers.

Another missing-link-of-a-character has recently come to my attention.

The material to which the following account refers consists of two specimens of *Remora remora;* both taken on the Third Bermuda Oceanographic Expedition of the Department of Tropical Research of the New York Zoological Society.

A. 88 mm. standard length, No. 9358, KOH No. 854, taken from *Carcharias obscurus*, at surface, May 26, 1931, near Nonsuch, Bermuda.

B. 15 mm. standard length, No. 23,459, KOH No. 1013, Net 1304, 8 miles southeast of Nonsuch, 400 fathoms, September 15, 1931.

Specimen B in life was purplish brown, the anterior portions of lips, tips of pectorals and outer tips of caudal lobes pale grayish. Both fish have been thoroughly dyed and cleared.

Examining the 88 mm. *Remora,* I wondered, as often before, at the extent of the protruding under lip in these young specimens.

The dye had made the remarkable teeth stand out with great distinctness. They somewhat resembled the teeth of a horse, rows upon rows of them, raised on the end of slender stalks and aligned in long palisades. In the lower jaw were still more dental multitudes, showing sharp, incurved hooks at the summits.

Cephalic Sucking Disk

The remarkably effective sucking disk on the head was fully developed and functional in this fish. Each half of the eighteen transverse lamellae consisted of a broad proximal sheet of tissue, giving rise, along the posterior edge, to more than 70 finger-like tentacles arranged in three rows; the anterior row of shortest ones numbered 40, a middle row of medium length tentacles had 17, and the posterior row of long ones had the same number.

I next examined a much smaller specimen less than an inch in standard length, 15 mm., and was at once impressed with the simplicity and undeveloped condition of the sucking disk. It was perfect in general shape, showing no transition from the original dorsal fin from which it was derived. The rays of the fin must at some still earlier stage have split, spread out sideways and become changed into movable, transverse plates which have the power of being raised and lowered and creating a vacuum. These plates in my infant shark-sucker were very imperfect. Instead of each lamella being armed with three rows of various sized tentacles and a complicated system of water-tight compartments, each half of a transverse section possessed only 6 or 7 long, flattened, thick tentacles with no developed flaps or membranes. In fact there was sufficient basal tissue only to hold the tentacles together. Their relative length in the two fish was 14 to 2; their relative average number 74 to 6.

It was evident that this elaborate and specialized structure was still in process of development, at present quite useless as the factor in progress and movement which it had been ancestrally when a proper dorsal fin. On the other hand, it was equally unable as yet to perform its ultimate, opposite function of an anchorage, an inhibitor of movement.

Such a condition in any organ implies one of two things, either that the creature can get along for a time without the ultimate change of function of the structure, or that it has some temporary

substitute which for the time being suffices as a stop gap. A glance at the jaws of the small *Remora* showed that the latter condition had been fulfilled.

We know nothing of the habits of the newly-hatched or post-larval shark-sucker, but it seems reasonable that as it is to spend its life creeping over the body of a shark or other large creature of the sea, that the sooner it develops some method of attachment, the better.

Labial Suckers

The teeth of our half-inch fish were few in number, minute and inconspicuous, but the fleshy portion of the lower jaw was

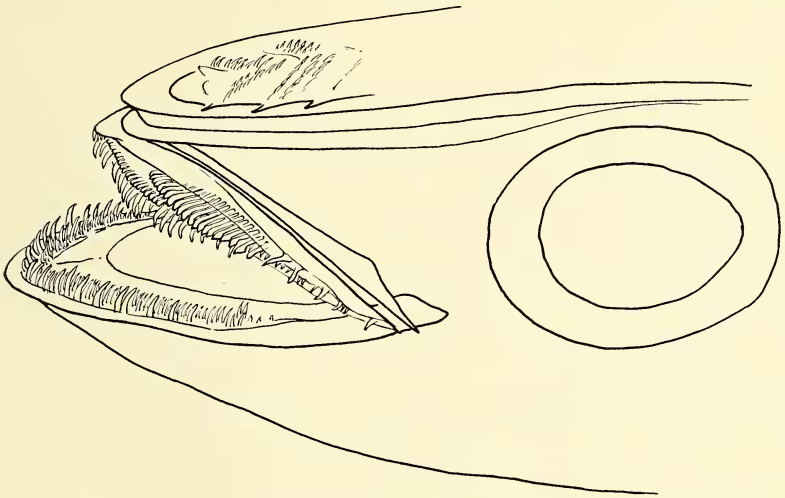

Fig. 34. *Remora remora*, 88 mm. Lateral view of head, showing complicated lines of teeth.

undershot even more than in the adult; precisely as 68 to 57, or a full fifth. This projecting lip and the anterior portions of the upper jaw were provided with a formidable armature of suckers, 26 in all. In general appearance they were like the corresponding organs on the arms of an octopus, a short, thick pedicle expanding distally into a rounded, inverted cup with a circular upper rim. The largest was .11 mm. in diameter. There were 6 along the anterior edge of the upper jaw, and 3 on each side of the symphysis, directed obliquely up and forward. On the lower jaw were 20 suckers, ar-

ranged in two rows, 12 along the edge of the jaw and 8 in a second line. Considering the suckers in one-half of the lower jaw, I found that in the first row the central four were small and placed close together, the outer two considerably larger, about twice, and well separated from each other. The second row showed a gradation in size from the symphysis outward, the outermost, however, being smaller than the corresponding one of the first row. The lower jaw suckers were directed upward and very slightly backward.

Teeth

The teeth were difficult to find, but once located were distinct. Near the front of both upper and lower jaws, but with a wide symphysial gap, was an upper row of 8 or 9 and a lower row of 8.

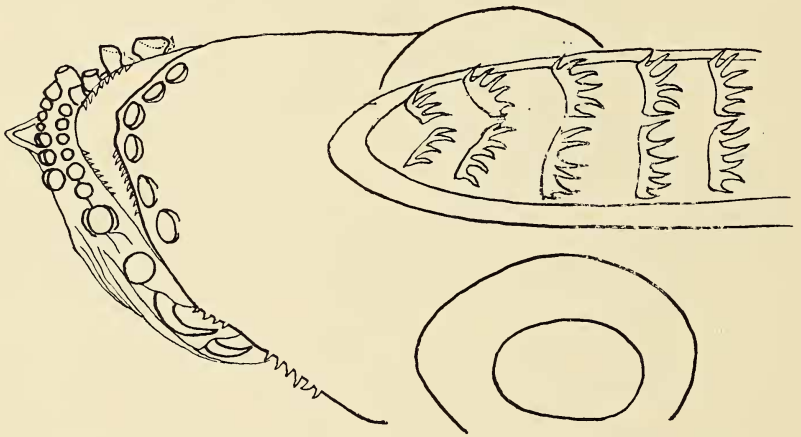

Fig. 35. *Remora remora*, 15 mm. Oblique view of head showing larval suckers, and undeveloped teeth and sucking disk.

Along the lateral edge of the premaxillary, where it overhung the mandible, and beyond the outermost sucker, was an irregular row of short, out-jutting teeth—10 to 15 in all.

Most remarkable, however, were two pairs of large, sharply curved fangs, beyond the outermost sucker on the lower jaw, and curved laterally and very slightly upward. The flatness of the curvature, together with their extra-buccolabial position rendered them useless for the capture or retention of prey, and unless they are of help in hooking over the upper jaw, thereby locking the two

together when these are in use as an attaching organ, I cannot divine their function.

Dr. Tåning[2] has studied post-larval stages of *Remora* and *Echeneis* from the point of view of the gradual shifting forward of the cephalic disk. Although he had specimens of *Remora remora* of 5, 6, 10, 12, 18 and 25 mm., he makes no mention of labial suckers, but in his illustration shows sparse but well-developed teeth along the lower jaw from the 9.8 mm. individual up to that of 25 mm. length. The situation of the disk in my 15 mm. specimen is more advanced than in Tåning's 18 mm. fish, as he writes of this individual, "*le bord antérieur du disque est placé au bord antérieur des yeux,*" while in mine the disk extends one-third of the eye's diameter in advance of the eye's anterior rim.

Scales

Scales are wholly absent from the 15 mm. specimen and in preserved remoras of large size the skin usually shows only irregular, deep reticulations of mucus, the scales being hidden in the sunken interspaces. In my cleared individual of 88 mm. the scales are conspicuous and cover the entire surface. They are small and exceedingly numerous and very characteristic in shape. There are about 40 scales to every square millimeter and a most conservative estimate of the body area gives a minimum total of at least 100,000 scales on head, fins and body.

Superficially they remind one of nothing so much as a multitude of the bowls of table- and tea-spoons stuck obliquely into the skin, with the concavities facing forward. If they were not imbedded in mucus during life they would form most efficient brakes on any rapid forward progress through the water. At first they seem to be quite irregularly inserted, and indeed there is no hint of regular rows for more than a few scales at a time, but in about three cases out of five and even more along the sides, each large scale has two small scales sprouting from its anterior base.

In the space of a square millimeter there are 12 to 15 large scales with attendant and other scattered small scales. Sometimes there is only one small scale to a large one, or three smalls may be in a longitudinal row to fill an interspace between two large ones.

[2] *Comptes rendus des séances de l'Académie des Sciences*, Vol. 182, p. 1293.

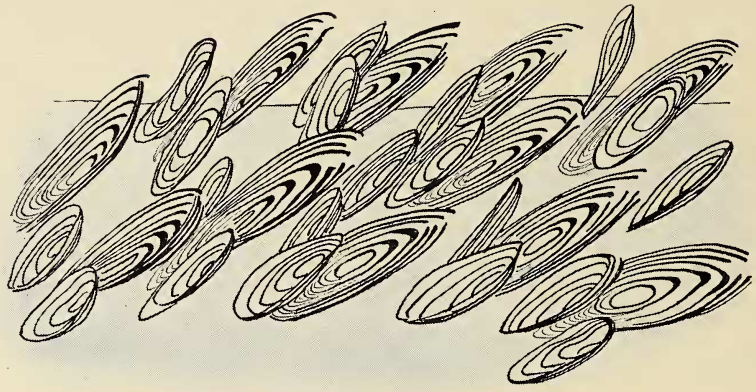

Fig. 36. Scales of 88 mm., *Remora remora*, horizontal view.

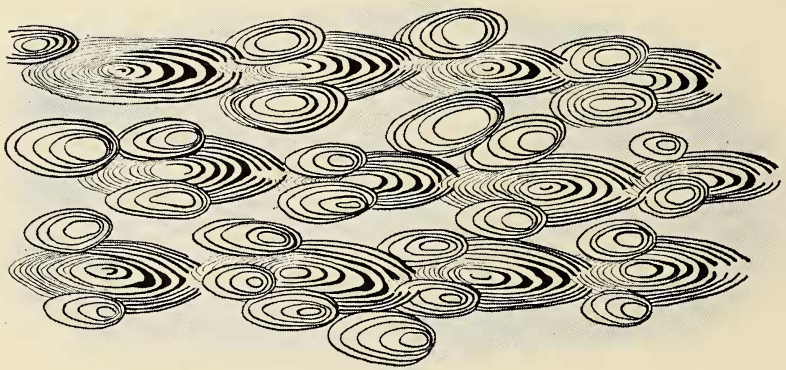

Fig. 37. Scales of 88 mm., *Remora remora*, vertical view.

The scales are regular ovals, the larger ones .33 and the smaller .11 mm. in length. In the cleared tissues their entire outline can be distinctly seen, all the circuli having taken up considerable stain. The rings vary from 6 to 12, usually 8, and they may be very thin and close together or thick. Starting from a small central oval they are all complete in the small scales and a few of the large ones, but in the majority of the latter they are broken or worn away at the tip so that the outermost three or four do not meet. This would suggest some use in regard to progress over the body of the shark, or of assistance in clinging. On the other hand, the terminal breaks may act as channels for facilitating the distribution of mucus. At present our safest comment is "I don't know."

The scales are identical in size, shape and structure everywhere on the fish. The only variation in arrangement is a diminishing number of small scales along the mid-back and mid-ventral areas, fewer of the regular trinities being found in these places than elsewhere. Scales occur on all available parts of the head, extend some distance up the pectorals and vertical fins, and almost to the tips on the ventrals and especially on the caudal.

The lateral line is very well marked in the dyed tissues, in the 88 mm. *Remora* the components taking up stain almost as thoroughly as bone. The line is composed of a series of deep-set, short, slenderly barrel-shaped segments, pointing obliquely out and backward, the upper end showing many fine perforations. Posteriorly these separate units elongate and form an almost continuous tube.

The line begins just beneath the shelter of the overhanging lateral edge of the sucking disk, at the vertical of the 13th lamella from the front, close above the insertion of the pectoral. It rises in a gentle curve, keeping parallel with the curving posterior end of the disk, and then, as gently, and in a long, even curve, slopes down to a level with the mid-side. This descending curve is so gradual that it does not straighten out until at the vertical of the origins of the soft dorsal and the anal fins. From here it extends straight backward, exactly bisecting the peduncle, and out to the very tail tip, ending in a long, colorless tube with slight openings here and there, its open end only 1.5 mm. from the tips of the central caudal rays.

In the 15 mm. shark-sucker the lateral line is also conspicuous but of course not nearly so deeply stained as in the more adult

specimen. It shows as a continuous line beneath the surface. The contour is different from that in the adult, there being no anterior rise, but the line dropping down in a long, rather straight descent from its origin above the pectoral, to the mid-line of the body. It is traceable only to the base of the caudal and not distinguishable along the rays.

Fins

The relative ontological changes in length of the disk and of the base of the soft dorsal and anal fins are best shown by the direct comparison of their percentages. In the 15 mm. *Remora* the length of the soft dorsal is 72 per cent. of the disk length, whereas in the larger, 88 mm. fish, the former has equalled and surpassed the disk by a third, measuring 133 per cent. The same is true of the anal fin length, this being 78 per cent. of the disk length in the young, and 142 per cent. in the older fish.

In both there are 18 transverse lamellae in the first dorsal or cephalic sucking disk. The soft dorsal count is 25½ in the small remora and 24½ in the larger. The first few rays increase rapidly in length, reaching greatest height at the 6th in the smaller and at the 8th in the larger, then shortening and rising gradually to the last, which is relatively twice as long in the 15 mm. fish as in the other. All the anterior dorsal and anal rays show a slight branching at the tip and a distinct segmentation, differing thus in no particular from the succeeding rays.

The anal count is 22 in the young and 23½ in the older fish. The pectorals are broad and rounded, with I, 20 in the young fish and I, 26 in the larger The spines are very strong and as prominent as are those of the ventrals, whose count is, of course, I, 5.

As regards the position of the pectoral fins, the small *Remora* shows a depth of body at the pectorals of only 37 per cent. of the larger. The position percentages of these fins can be compared directly with one another:

15's depth at pectoral compared with 88's—37 per cent.
15's distance from dorsal surface to pectoral, to 88's—50 per cent.
15's distance from pectoral to ventral surface, to 88's—50 per cent.
15's vertical base length of pectoral compared with 88's—25 per cent.

So the relative dorso-ventral position is changed hardly at all in the two, the shift in measurements being due to the great relative

increase in the vertical extent of the base of the fin itself, from less than a third to almost one-half of the entire body depth.

The ontological changes in length of the paired fins offer great contrasts; in the half-inch *Remora,* in comparison with the head length, the pectoral length is 38 per cent., and that of the ventrals 24 per cent. In the 88 mm. fish both are exactly the same length, the ventrals having caught up with the pectorals, an increase of over half, or 54 per cent. of the length of the head.

The ventrals are quite free in the post-larva, indicating better natatory ability than in the older individual. In the latter the spine measures 12.8 mm., and the inner or 5th ray is 8.5 mm. long, and for exactly two-thirds of this length the ray is bound tightly, goby-like, to the skin beneath.

The outer, functional caudal rays in the small *Remora* are longer than the central ones, but that is all that can be said of the shape. The 88 mm. fish has a slightly emarginate or shallowly forked tail, the inward slope being almost straight. The count is:

15 mm. – (9)9 + 8(8)
88 mm. – (13)9 + 8(12)

The most striking thing about the tail in the larger fish is the fact that all the functional caudal rays, except the central two, are split vertically and sprung widely apart at the tips for a distance of 5 mm. This is independent of the usual distal branching of these rays. It is very slightly noticeable in the small specimen. The tips of the two central rays which bound the end of the lateral line, are normal and the tips strong and unsplit. In the case of several hundred species of deep sea and shore fish which have been cleared and stained by an identical process, this splitting has occurred only in this species. While it may very possibly have no important significance whatever, yet is it worthy of note that the cephalic disk was probably originally formed by the lateral splitting of the rays of the first dorsal fin.

General Proportion of Growth

In the case of six measurements I am able to compare fish of four ages:

A—is my 15 mm. Remora.

B—is a Remora taken at sea 35 miles southeast of Beaufort, North Carolina (Gudger, 1926).
C—is a fish which I collected at Key West (Gudger, 1926).
D—is my 88 mm. Remora.

The measurements are the times contained in the standard length and show an almost uniform progression:

	A	B	C	D
Total length	17.6 mm.	30 mm.	49 mm.	105 mm.
Standard length	15 mm.	27 mm.	43 mm.	88 mm.
Disk length	3.88	3	2.96	2.8
Disk width	16.5	6.75	7.17	5.6
Head width (at base of P)	8	6.75	5.7	5.2
Head length	4.3	3.6	3.5	3.3
Length base of soft dorsal	2.7	2.8	3.4	3.7
Length base of anal	3	3.18	3.58	4

Relative measurements between my two fish are as follows:

Standard length	15 mm.	88 mm.	17 per cent. of 15 to 88 mm. fish.
Depth (in length)	1.6 (9.3)	11.5 (7.6)	14 per cent. of 15 to 88 mm. fish.
Head (in length)	3.48 (4.3)	23.5 (3.3)	14.8 per cent. of 15 to 88 mm. fish.
Eye (in head)	.91 (3.8)	4.5 (5.2)	20 per cent. of 15 to 88 mm. fish.
Snout (in head)	1.18 (2.9)	11.5 (2)	10.2 per cent. of 15 to 88 mm. fish.
Maxillary (in head)	1.67 (2)	11 (2.14)	15.2 per cent. of 15 to 88 mm. fish.